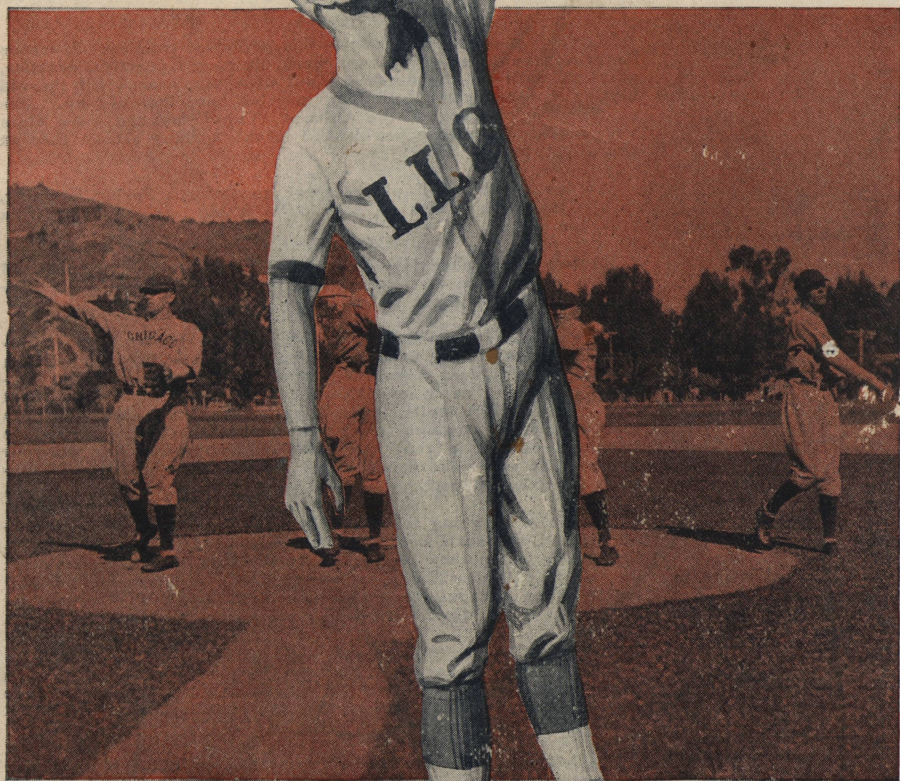


CHICAGO ENGINEERING REVIEW

The Monthly Publication of the ~~L~~ ~~ook~~ ~~e~~ ~~S~~ ~~chool~~ ~~of~~ ~~E~~ ~~lectricity~~

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"Training First"

[See Next Page]

The New Ford Car—New Rail-
way Signaling Course—A School
for Good Lighting—What's New
In Electricity—Starterless Motors

**MARCH
APRIL
1928**



Training First!



O TO Florida, California, Texas and the Gulf Coast district right now, and you'll find these places crowded with big league ball-players down south for Spring Training.

They're all there—Ruth, Gehrig, the Waner brothers, Alexander, Root, Collins, Speaker, Hornsby, O'Farrell, Hoyt, Pennock, and all the rest. After a winter of idleness, even the biggest stars in the game have to go through the Spring training season to get in condition.

It's no joke—it's no vacation—this period of training. It means hours and hours of good, hard work. It means practice, practice, practice, until all the kinks are out of a man's arm, till the old batting eye has come back and muscles have loosened up. One of the star pitchers of the Chicago "Cubs" told me more stars were made and more hopes dashed in the training season than at any other time.

Just as the baseball player must go through Spring Training, so the man who wants to hold down a big-pay job must train first, too.

No two ways about it—an untrained man can't step out and hold a real job in electrical work, any more than a ball player can do his best without training.

He can get an ordinary job—a blind-alley job—with no training. But if he expects to travel in "fast company," in a big league job, he simply must have the proper knowledge and skill. Anybody can play "sand lot" baseball Saturday afternoons without any practice. But major league stars aren't made that way. It's the grind of the training camp that makes the star, and it's the training you get in that half hour or hour every day on your Course that will make you a star in Electricity—a \$70 to \$200-a-week Electrical Expert.

The player is going to make mistakes—he will do things wrong at first. How much better to do them wrong during the training season, when they can be corrected, than to make errors out on the field, under the eyes of thousands of people! And how much better for you to make your mistakes BEFORE you get out on the job, than afterwards, when it's too late to change them!

Spring Training is good business for the baseball star. It's good business for you, too. Dig in HARD on your lessons these next months, and you'll quickly see the results. Make this YOUR "Spring Training" season.

The fellow who wins, whether in baseball or in the bigger, more important game of electricity, is the one who is TRAINED and ready.

Be ambitious! Set your heart on the biggest jobs in the electrical profession! But remember—TRAINING FIRST!

L. L. COOKE.

The background of the picture on our cover this month shows the Chicago "Cubs" in their Spring Training Camp, Catalina Island, California



A Description of Some AIR CIRCUIT BREAKERS

THE following is a description of air circuit breakers, the purpose of which is to call your attention to some of the features that often go unnoticed.

The earliest circuit breakers were knife switches with automatic means of opening them but the rapid burning of the knife blades and jaws soon led to the use of carbon contacts to break the final arc. At the same time that carbon type breakers were coming into use, breakers with magnetic blowouts were being developed. These had brush type contacts shunted by auxiliary contacts that opened in an intense magnetic field which lengthened the arc and thus extinguished it. But as electric railways came into use more and more, circuit breakers were required to break heavier currents and it was finally discovered that the magnetic blowout alone was not sufficient to quench the arc.

Present types of circuit breakers have three sets of contacts. Fig. "A" shows a Westinghouse air circuit breaker which will illustrate essential parts. The main contacts consist of two copper studs bridged by the moving contact "A" which is built up of laminated copper. This contact affords a wiping action when the breaker is opened or closed, thus keeping the surface of the contacts clean. The arcing contacts

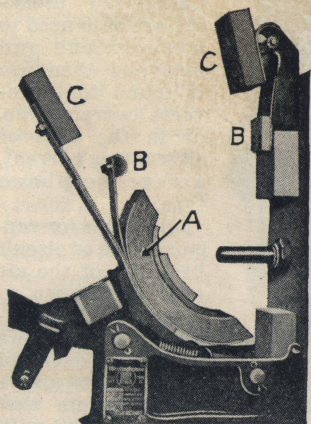


**Fig. A.
Showing
the Main,
Arcing
and
Carbon
Contacts
of a
Westing-
house
Air Cir-
cuit
Breaker**

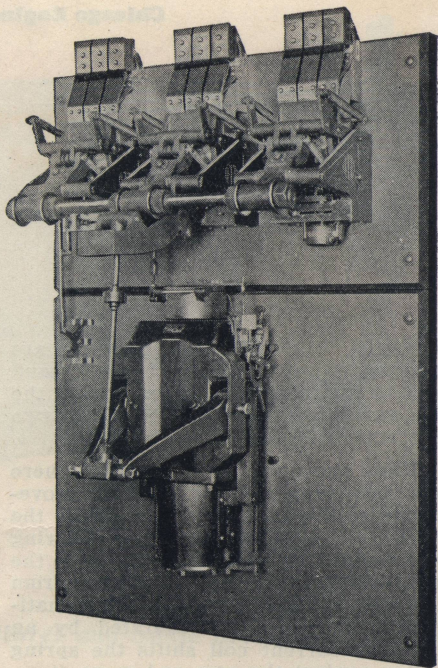


**Photo by the Cutter Co., Philadelphia
Remote Controlled Air Circuit Breaker
Capable of Breaking Current of 6,000
Amperes**

"C" are carbon blocks, one of which is stationary, the other being mounted on a moving arm of the breaker. The intermediate contacts "B" are copper and serve to shunt the contacts "D" when the moving contact "A" is opened.

When the breaker opens, the main contacts part first but since they are shunted by the intermediate or arcing contact "B" very little arcing occurs. Current is now carried by the "B" and "C" contacts, mostly by the former. Carbon is a much poorer conductor than copper and therefore if the change were made from the main contacts to the carbon or arcing contacts in one step, there would be considerable voltage across the main contacts causing them to burn, hence, the intermediate contacts, which are more simple in construction and more easily replaced, withstand the arcing.

As the intermediate contacts part, the load is shifted to the carbon blocks which finally break the circuit, by lengthening the arc. There are several other factors which assist in lengthening the arc aside from the movement of the carbon blocks, namely the tendency for an electric arc to rise, and the magnetic effect. As the arc rises it forms a loop with lines of force inside and out-

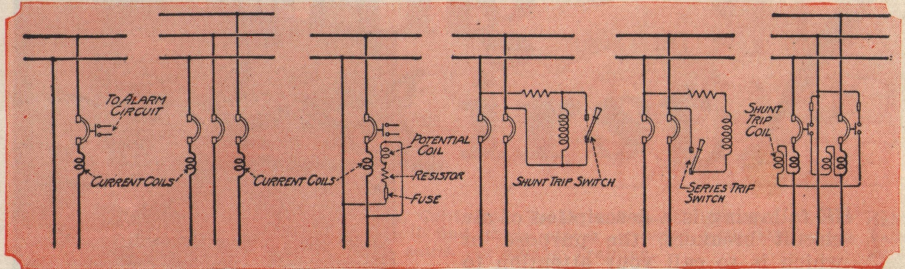


Fig. 1 **Fig. 2** **Fig. 3** **Fig. 4** **Fig. 5** **Fig. 6**

side of it. Inside the loop the lines are crowded together. They try to expand and in so doing, further lengthen the arc, causing it to break. These last two characteristics are very important.

When closing a circuit breaker, there are two separate and distinct movements of the arm. The first closes the contacts against the action of a spring and completing the movement locks the arm, taking the spring action away from the arm. When the breaker is automatically opened, a trip operated by an overload current coil shifts the spring action against the arm and opens it.

Large circuit breakers opening more than one line are provided with some means of isolating the arcs. These are known as barriers. A breaker of this type made by the Cutter Electrical Mfg. Co., Philadelphia, is shown in one of the Photographs. Another photograph shows remote control type of breaker made by the Cutter Co., capable of breaking circuits having current capacities up to 6,000 amperes. The manufacturers state that they are at the present time, building an air circuit breaker capable of interrupting a circuit having a capacity of 45,000 amperes.

Circuit breakers have automatic tripping coils to meet different line conditions. The simplest is the current overload breaker which has a coil connected in

series with the line. If the supply line is a grounded system, the current coil must always be connected in the ungrounded side of the line, to make sure that the total current flowing in the line passes through the current coil.

Another development is an inverse time limit action which does not permit opening of the breaker on a momentary overload as in the case of starting a motor or a short which burns itself out immediately. To give the time limit action, a dashpot filled with oil is usually provided and equipped with a means of varying the time taken by the oil to pass through the valve. Current ratings are varied by changing the air gap between the magnet core and the armature fastened to the tripping latch.

Another type of circuit breaker is the under-voltage type having a shunt coil which operates the tripping latch. This form is sometimes combined with the overload type in which case the breaker is provided with two windings. Under-load breakers are also used to some extent and now and then use is found for a reverse current type, or in the case of alternating current, a reverse phase type.

Diagrams for various types of circuit breakers of the air type are shown in Fig. 1 to 6 inclusive. Fig. 1 shows a simple overload type for a two wire circuit. Note that it is equipped with

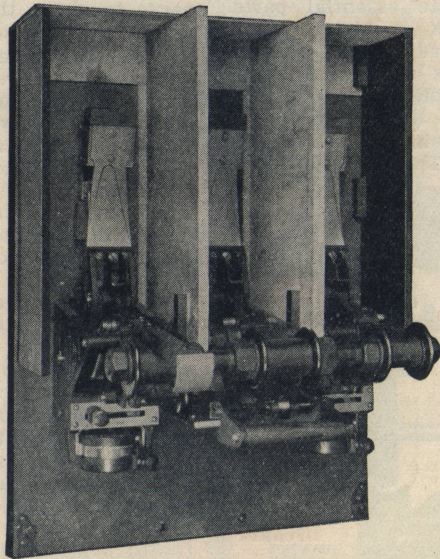
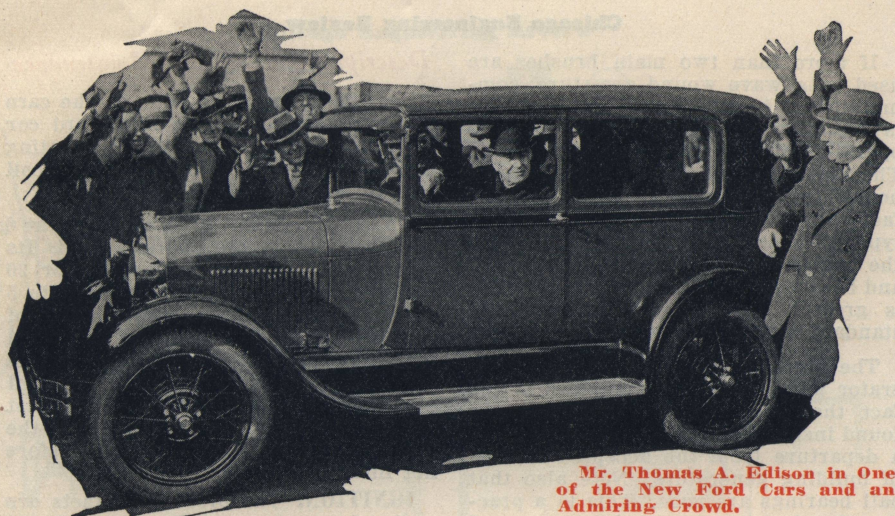


Photo by the Cutter Co., Philadelphia.

Multiple Arm Circuit Breaker with Barriers

(Continued on Page 14)



Mr. Thomas A. Edison in One of the New Ford Cars and an Admiring Crowd.

The New FORD CAR

A Description of the Electrical Features and Some Maintenance Tips

PERHAPS no new car has created so much interest as the 1928 Ford.

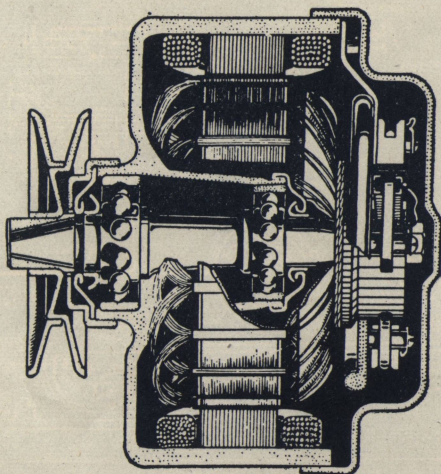
Most of the new Ford cars are to be seen only in the display rooms as yet and it is not certain just when Mr. Ford will have his plants operating at normal production.

One of the several outstanding electrical features is the new method of mounting the distributor over the engine, thus saving long rubber covered high tension cables and reducing insulation leaks to a minimum. The spark plugs connect to the distributor terminals by means of phosphor bronze clips which are only a few inches long as will be seen by consulting the illustration and the diagram.

It will be noted that the Model A Ford uses but one induction coil as compared with four on the old Model T Ford car.

The Breaker for this coil is mounted in the distributor head

Another outstanding feature is the generator. It is a six pole generator having a wave wound armature and is equipped with five brushes. Four of these are current collectors for the battery, ignition and lighting circuit, the fifth being the field brush corresponding to the third brush on the standard generator.



Section View Showing Hollow Armature and Bearing Arrangement of the New Ford "Power House" Type Generator

It might be well to explain here that this same generator could be equipped with two main brushes, four main brushes or six main brushes for the simple reason that a wave winding is a series winding. Standard four brush generators of the wave wound type are equipped with only two main brushes but could be equipped with four such brushes if desired.

If more than two main brushes are used on a wave wound armature, commutation is improved, that is all. There is no other difference insofar as the operation of the generator is concerned. The manufacturer calls this a "power-house" type of generator because of the fact that the armature resembles that type of generator in being narrow from the commutator end to the pulley end and because of the fact that its diameter is greater than is generally used in standard automobile generators.

The big difference between this generator and other generators lies in the fact that the front bearing is to be found inside the armature. This is quite a departure from the accepted method of building generators. Note also that ball bearings are used. This is a practice that is being resorted to more and more by electrical manufacturers, and now it is not uncommon to find ball and roller bearings used on large motors. Carrying the subject of bearings still farther, railroad cars are now being built with roller bearings so don't be surprised when you find roller or ball bearings in unfamiliar places.

The starting switch is mounted on the frame of the starter motor and operated by a long rod and pedal from the foot board. This is another move toward simplification, doing away with several exposed connections.

Description, Care and Maintenance

Here is the advance dope on the care and maintenance of the new Ford car which uses a Ford generator, starting and lighting system, an Auto-lite coil and an American Bosch distributor.

BATTERY. A Ford battery rated at 6 volts and 80 ampere hours is used. Its starting capacity is 98 amperes for 20 minutes and the lighting capacity is 5 amperes for 16 hours. The positive of the battery is grounded. It is mounted on the left frame under the floor boards of the front compartment. The terminal assembly on the Model A Ford is just the opposite from that used on the Model T Ford and the two are therefore not interchangeable.

IGNITION. The breaker contacts are made of tungsten and separate .018-.022 inch. If these must be resurfaced, use a flat jeweler's file or a medium hard oil-stone. The distributor is not automatically advanced but is manual, the maximum advance being 20°. The spring tension on the breaker arm should be from 14 to 20 ounces. The ignition current will be about 6 amperes at 7 volts, that is, when the generator is charging the battery. At 6 volts, that is, when the engine is stopped, the ignition current will be a little over 5 amperes.

Put a few drops of light engine oil in the distributor oiler every 1,000 miles.

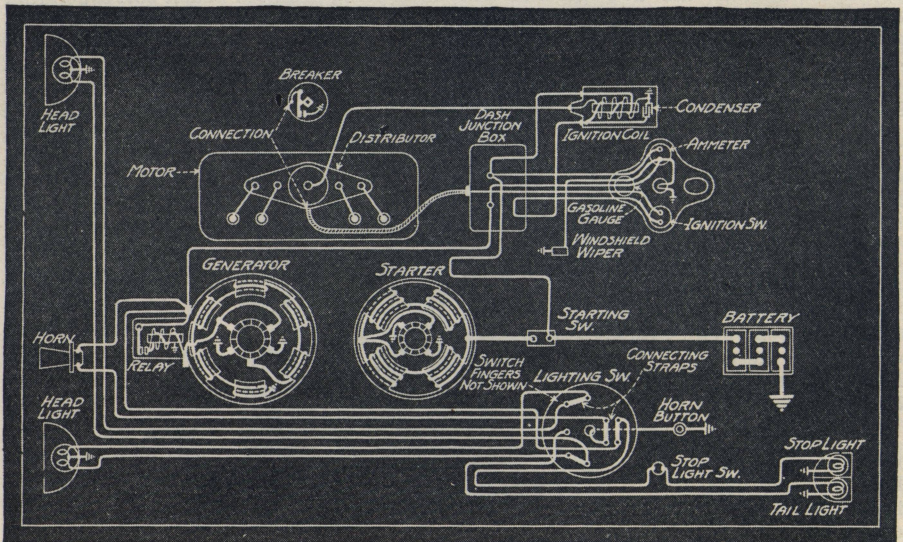
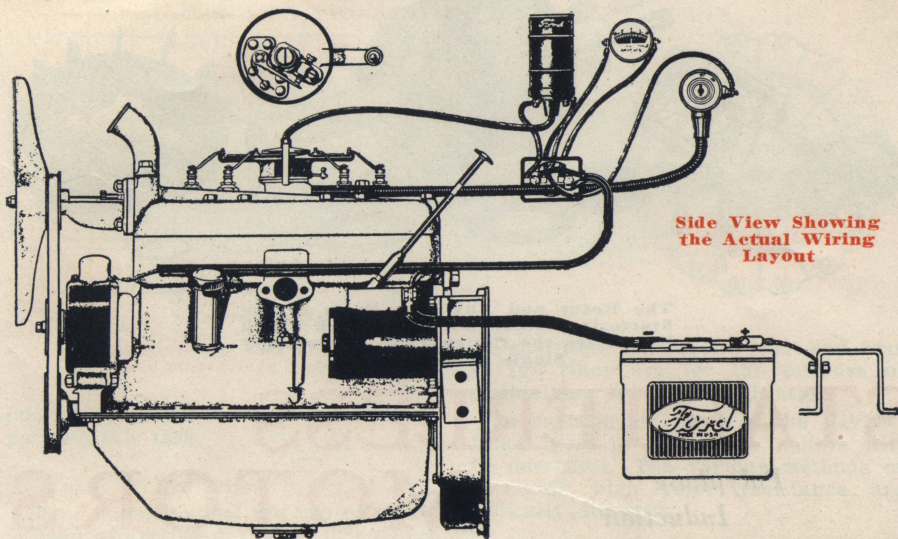


Diagram of the Ford Electrical System. The Ignition Circuit is Another New Departure



This is located on the side of the distributor housing and will be seen in the side view of the engine and electrical assembly. The breaker arm cam, a top view of which is shown above the distributor should be wiped with a little cup grease each time the distributor is oiled.

The distributor is mounted over the engine between cylinders 2 and 3. The breaker mounting plate can be removed by removing the distributor cap and removing the lock screw in the center of the breaker and breaker cam. The plate should be turned until the groove and projection on the housing line up. Next lift the breaker plate.

The breaker lead is run through armored cable to the ignition switch, making it impossible to shunt the ignition switch without sawing the cable. This makes the car practically theft proof so far as operating the car under its own power is concerned. If it becomes necessary to remove the distributor housing or ignition switch both must be removed at the same time as a unit, because of the cable connection.

TIMING THE IGNITION. The breaker contacts separate when the piston entering the power stroke, reaches top dead center. If it is desired to set the timing, crank the engine until piston No. 1 top dead center on the compression stroke. During this stroke, both valves will be closed. Next loosen the screw in the center of the breaker cam and rotate the cam until the contacts just begin to open.

Then tighten the screw.

FIRING ORDER. The firing order is 1-2-4-3.

SPARK PLUGS. The spark plug gaps are .025 inch, and they are $\frac{7}{8}$ -18 S.A.E. thread.

STARTER. The starter connects to the engine by means of a Bendix drive. Its rotation is anti-clockwise considered from the commutator end. Brush spring tension should be 2 pounds.

The starter bearings do not require attention. They are oilless.

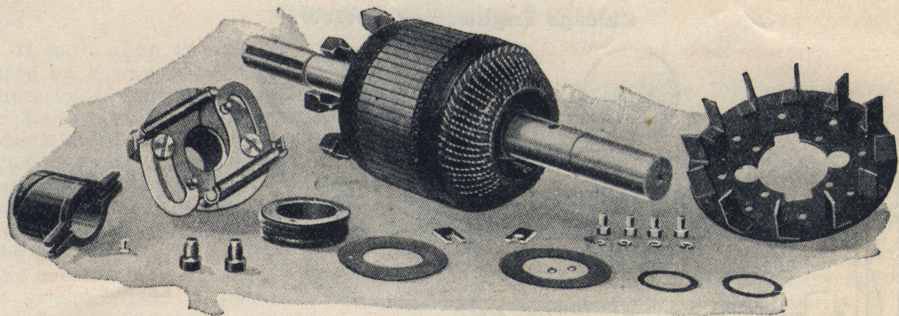
To remove the starter, first disconnect the starting pedal and cable from the switch. Next remove the three flange mounting screws and pull the starter forward and lift it from its place.

GENERATOR. Rotation of the generator is anti-clockwise considered from the commutator end. Regulation is by means of a field brush, same as the third brush method in which the voltage across the shunt field is varied by the number of armature coils included in the field circuit.

If the generator output needs adjustment, just remove the commutator cover cap and loosen the small screw holding the field brush on the fiber mounting ring. Move the brush in the direction of rotation to increase the charging rate and in the opposite direction to decrease the charging rate. Tighten the screw after making the adjustment.

Brush tension on the generator brushes should be from 12 to 16 ounces each.

(Continued on Page 9)



The Rotor and Auxiliary Parts of the Starterless Motor. Note the Clutch Which Resembles the Clutch Used on Ordinary Single Phase Motors

STARTERLESS MOTORS

Polyphase Induction

THE present trend in motor design (up to 5 H. P.) is toward a starterless motor, that is, one that can be thrown directly across the line without the use of a compensator. Compensators are expensive, require additional space and make wiring problems more complex.

The squirrel cage motor is a simple rugged piece of machinery and efficient too, but at starting it must draw a mighty heavy current in order to produce from 125% to 150% of full torque load, usually from 500% to 600% of full load current.

The wound rotor motor has a good starting torque but in order to be brought up to full speed, it must have a low resistance rotor. It also requires a rheostat with outside connections and resistors.

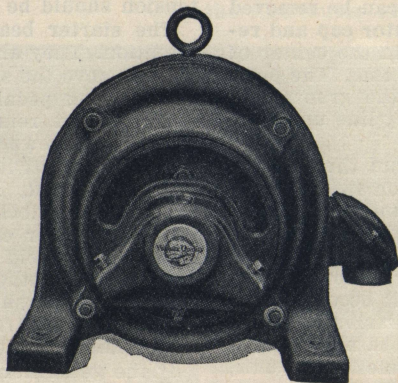
The Wagner starterless motor which will be described in the following paragraphs, is a combination slip ring and squirrel cage motor, having both a low resistance and a high resistance winding, the low resistance winding or squirrel cage winding occupying the innermost space and the high resistance or insulated winding occupying space near the surface of the rotor, where it

can be easily removed in case of injury.

Arrangement of Windings

The arrangement of the two windings is shown in Fig. 1. Here it is seen that taps are brought out from the insulated winding to segments. Below 70% of running speed the connections are open as shown, giving the motor a high resistance rotor for starting. This causes the motor to develop good starting torque at moderate starting current. As the motor picks up its load, a centrifugal governor mounted on the shaft throws a set of short circuiting segments across the taps, reducing the rotor resistance and giving the motor the characteristics of a squirrel cage motor.

An idea of the current and torque characteristics of the Wagner Pow-R-full



The Wagner Starterless Motor Assembled

starterless motor can be had from the chart in Fig. 2. These curves or characteristics are the same for each starting operation since the "throw-over" depends on the governor which in turn depends on the speed of the rotor. It takes the human element out of motor starting. No two men start a motor in the same way. This is known to every

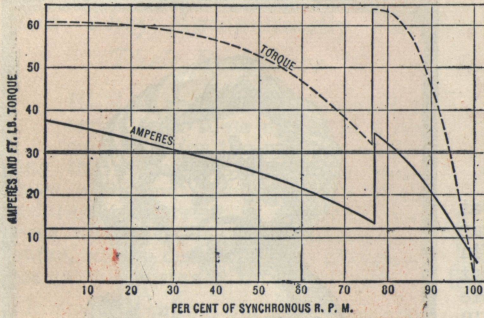


Fig. 1—Diagrammatic End View of the Wagner Starterless Motor

one who has ever watched several men perform this task.

Protection

Some states compel the use of a low voltage protective device to disconnect a motor in case the voltage drops and to prevent automatic starting of the motor when the voltage comes on again.

All types of motors must be protected by fuses or by a circuit breaker having as many poles as there are supply lines. This is a rule of the National Electric Code issued by the National Board of Fire Underwriters to protect any motor from an overload or protect the circuits from the effect of short circuits.

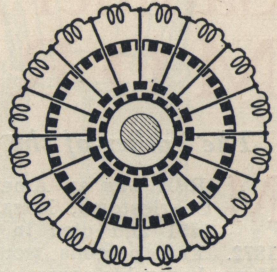
An "across-the-line" starter of the type used for polyphase induction motors under 5 horsepower may be used. It must of course, have a rating in accordance with the motor rating but needs only a no voltage release to open the contactors at reduced voltage and inverse time-element overload protection.

Starterless motors are well adapted to remote control installations, such as pump motors which must be controlled by float switches or air compressors controlled by pressure gauges.

Construction Details

An idea of the construction details of the Wagner starterless motor can be had from the accompanying photographs. The rotor will be of particular interest since this is the heart of the starterless feature. The centrifugal governor is the same in principle as the cut-out used on the fractional horsepower single phase motors employing a temporary starting winding.

How the Starterless Motor Behaves



Fans used on both the front and rear of the rotor are for the purpose of maintaining a forced ventilation.

In subsequent issues of the Review, other types of starterless motors will be described. The various methods of obtaining high rotor resistance are radically different.

The New FORD CAR

(Continued from Page 7)

The ball bearings on the generator are packed with cup grease, the grease compartment forming a hollow tube inside the armature. The grease compartment can be repacked by removing the drive pulley and the end cap.

The tension of the drive belt is adjusted by swinging the generator on the lower mounting lug. The belt must not be too tight or it will crowd the bearings.

The relay is the usual type and is mounted on top of the generator.

LIGHTING. The headlights are standard Ford 6-8 volt bulbs. These have two filaments rated at 21 and 2 candlepower, the latter being used for dimming. Dash and tail lights are 6-8 volt 3 candlepower bulbs. The stop light is a 6-8 volt 21 candlepower bulb. Dash, tail and stop lights are of the single contact type.

A Correction

In the January Review under the heading "How to Install the New Non-Metallic Cable" it was stated that this cable was developed for the purpose of replacing armored cable in old housewiring. This statement may give the impression that non-metallic cable is for use in old houses only. Such is not the case, however. It may also be used in the wiring of new houses in accordance with the rules outlined in the January issue of the Review.

Samuel F. B. MORSE

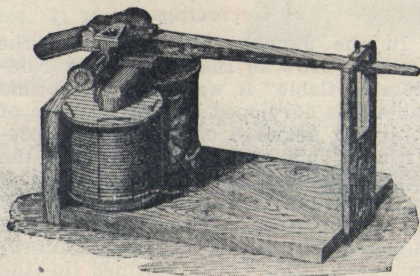
The Father of the Telegraph

MORSE was an American, born at Charlestown, Mass., in the year 1791 and died in New York in 1872. Few persons would guess that Morse began his career as an artist. He graduated from Yale University in 1810 and after beginning life as an artist, made several trips to Europe to continue his studies and training. He received a professorship in art in New York City, so we can be sure that his ability along this line was above the ordinary.

It was on one of his return trips from Europe that he conceived the idea of the telegraph. This was in 1832. While discussing the then recent discovery and science of a method of increasing the strength of a magnet, by passing an electric current through coils of wire wound around a soft iron bar, the idea of an electric telegraph came to his mind.

In September, 1837, he made a public exhibition of his telegraph and in that year filed his claims at Washington. In 1838 he asked Congress for funds with which to construct an experimental telegraph line from Washington to Baltimore and after almost despairing of this aid he was surprised to learn that Congress, in 1843, after a period of five years, had appropriated \$30,000 for this line.

In 1844, Morse succeeded in completing a working telegraph line between Washington and Baltimore and demonstrated to the world, that the electric telegraph was practicable and usable.



Morse's First Telegraph Instrument



Samuel F. B. Morse

It seems somewhat strange to us to learn that his first telegraphs were more complicated than those which followed soon after. His idea of a telegraph was an automatic transmitter and an automatic receiver, one which would record the signals on paper, or in other words, the printer telegraph.

It was said that Morse was chagrined that the operators as they became skillful, could read the messages by sound without the aid of a permanent recorder. When it was learned that operators could send and receive without this complicated equipment, it was of course discarded. Again the tide has turned the other way for we now find the printer telegraphs are superseding the Morse lines.

The first practical application of electricity in warfare must have been the telegraph. We find that it was used in the Civil War to good advantage and certainly in the World War the telegraph also played its part.

The number and character of honors bestowed upon Professor Morse because of his invention of the telegraph have probably never been equalled in the case of any other American.

In October, 1842, he laid the first submarine line across the harbor of New York and later gave valuable assistance to Peter Cooper and Cyrus W. Field who financed and laid the first submarine cable across the Atlantic Ocean.

Ballast Resistors

How They Automatically Vary Their Resistance

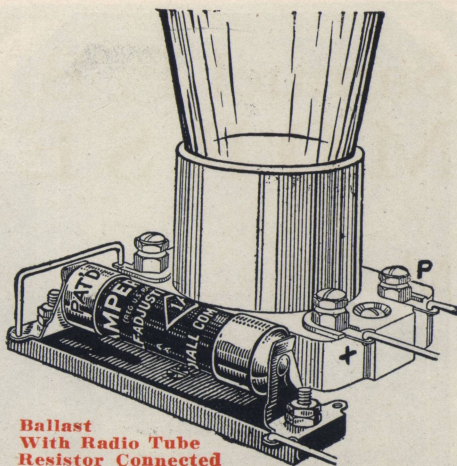
WHEN a resistor is connected in series with some device in a circuit, it is for the purpose of limiting the current to a certain value. There are some cases where a slight variation of current in a circuit may prove objectionable, this variation, of course, will be due to voltage change or change in resistance in the circuit.

In some circuits a variable resistance may be used to accomplish the desired result or where the equipment in the circuit is elaborate, a voltage regulator may be used. However, in unimportant circuits, the best way to automatically regulate the voltage is by means of a ballast resistor.

Rheostats are not being used as extensively in radio receivers at the present time. There is no way of knowing the current in a vacuum tube filament without measuring it with an ammeter, therefore, the use of a rheostat is more or less guess work making it necessary for the operator to gauge his adjustments by the tone of the set. A ballast resistor will maintain the current at approximately the same value regardless of the condition of the battery. These are simple in construction being much the same as a grid leak.

The radio ballast resistor, consists of a short length of resistance wire sealed in a glass tube filled with gas. When the normal current flows, the resistor becomes quite hot, the heat being conducted to the walls of the tube where it is given off to the surrounding air. In case the voltage should increase due to the battery being charged, the current would tend to increase.

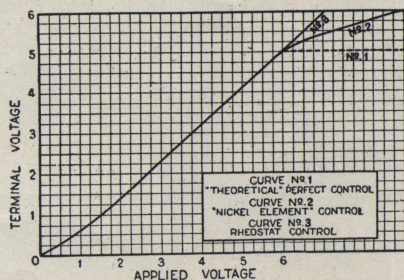
However, the increase of current would not be in proportion to the increase in voltage for the following reasons: The resistor will increase its resistance as its temperature increases. Ordinarily, the difference in temperature would not be great enough to cause any material change in resistance for the air would carry off the heat generated and keep the conduction cool.



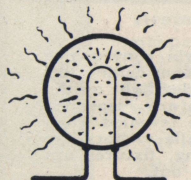
Ballast With Radio Tube Resistor Connected

Not so with the ballast resistor for the tube contains a gas having poor conducting qualities when the gas is heated. Thus, when the heat is not carried from the resistor to be dissipated to the air, the resistor becomes very hot. This increase in temperature is not in proportion to the increase in current, consequently the current is kept at almost constant value.

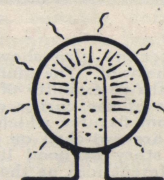
The accompanying curve shows the characteristics of a ballast resistor used for radio vacuum tubes. If correctly designed, a ballast resistor will keep the filament current at $\frac{1}{4}$ ampere causing the tube to operate at the current for which it is designed. There are other advantages, namely reduced cost of parts, conservation of space and simplicity which will help to cut down maintenance costs.



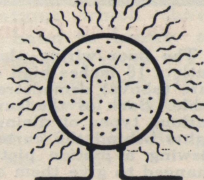
How a Ballast Resistor Functions



Normal-Gas a Fair Heat Conductor



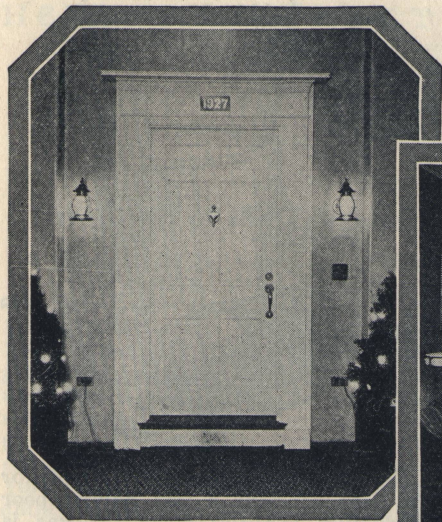
Gas Hot—A Poor Heat Conductor



Gas Cold—A Good Heat Conductor

Demonstrating the Well-Lighted Home

Nela School of Lighting at Nela Park, Cleveland, conducted by the National Electric Light Assn., exhibits house wiring, the advantages of shaded light for decoration and comfortable illumination, the use of proper home lighting, and the variety of good lighting equipment now on the market. (See Page 14.)



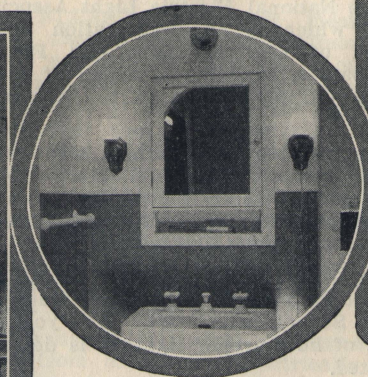
Where "Welcome" Shines

Illuminated house numbers, artistic entrance lanterns and outdoor Christmas tree lighting combine to greet the visitor who comes to see the model lighting in the Nela Park apartment. Note the convenience outlets serving the little trees. Between 12,000 and 15,000 Nela School visitors are invited to view this apartment each year.



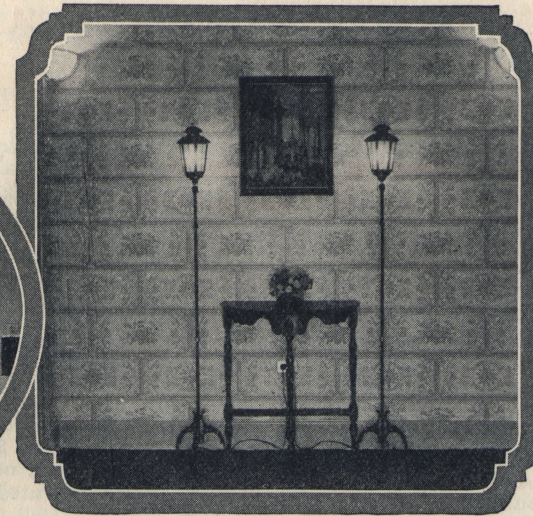
Various Fixture Types Can Be Displayed

The lighting is so installed that several types of good equipment can be displayed and demonstrated without making the rooms look like store displays.



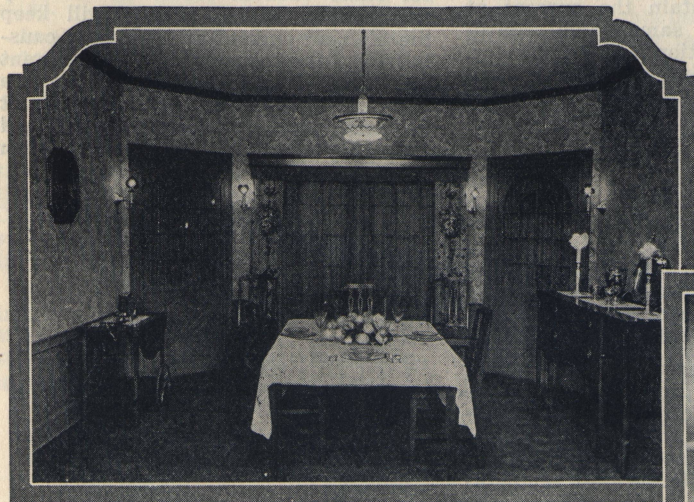
Proof by Contrast

The all too common single bare lamp and drop cord, and even the shaded light over the mirror in this bathroom are put to shame by the excellent illumination provided by the two cheerful lights, one on each side of the mirror.



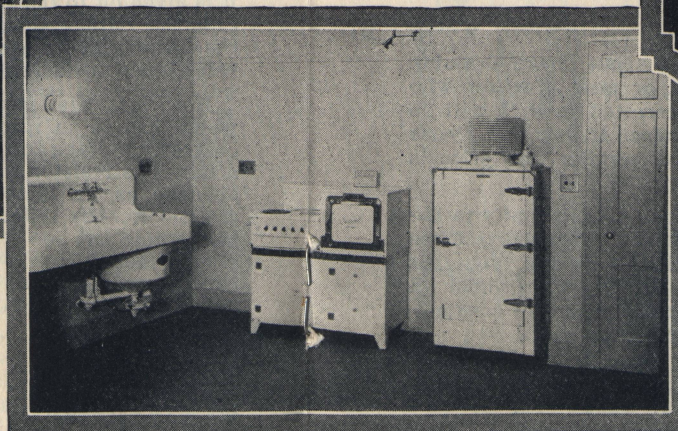
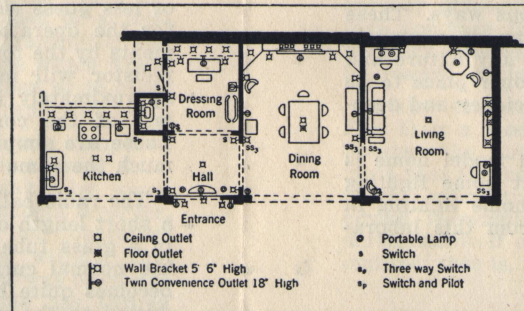
Hall Hospitality

The picture at the right shows three types of fixtures which enable light to make warm the welcome to the home. Any one of these types, used alone, will establish an atmosphere of hospitality and also beauty in any home.



Floor and Ceiling Outlets Serve Dining Table

The floor wiring plan (center) also shows twin convenience outlets 18 inches high on the wall. The dining room ceiling fixture (above) demonstrates the desirability of shaded light on the table. Back of the curtains of the corner doors are suspended various types of dining room fixtures which are revealed when lights behind the curtains are switched on. While visitors are viewing a motion picture story of good lighting, fixtures are changed to give them a different idea as they go out.



Illuminating the Bedroom and the Kitchen

All the lights are turned on in the bedroom (above) and it looks a bit confusing, but when you visit the Nela School of Lighting all these lights are demonstrated in suitable combinations which show how proper illumination lends a hand to beauty and an aid to rest. Other types of kitchen units are shown behind a screen in the wall. When these are turned off they vanish, leaving only the wall in view.

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Registered U.S.

Patent Office



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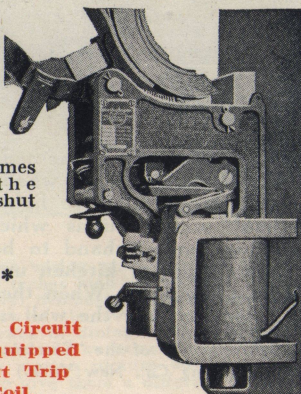
A Description of Some Air Circuit Breakers

(Continued from Page 4)

an auxiliary alarm which signals the operator who may be away from the operating board or might for some reason fail to heed the fact that the breaker is open.

Fig. 2 shows a three pole breaker connected in an Edison three-wire circuit. All arms are mounted on the same bar causing all arms to be opened simultaneously. The usual under-voltage trip used in connection with an overload trip is shown in Fig. 3. A resistor and fuse are connected in series with the under-voltage coil for protection, the resistor making it possible to connect a manual tripping switch in shunt with the coil without the necessity of opening the under-voltage circuit. Such a connection is shown in Fig. 4. With this arrangement, the switch is usually left open. However, the switch may be of the normally closed type and connected in series with the under-voltage coil as in Fig. 5.

There are instances where several motors operating industrial machinery are dependent on one another and yet cannot be protected by the same circuit breaker. In such cases it may be desirable to shut them both off in case either one is shut down. To accomplish this automatically, an interlocking arrangement may be used as in Fig. 6. The shunt coils are strictly for the purpose of tripping and must not be confused as under-voltage coils. If for any reason one motor becomes disconnected, the other will be shut down also.



**Westinghouse Circuit
Breaker Equipped
with a Shunt Trip
Release Coil.**

* * *

A School for Good Home Lighting

(Pictures on Pages 12 and 13)

The National Electric Light Association, which is an organization composed of Electric Light and Power Companies, conducts a school of good home lighting at Nela Park, Cleveland, Ohio.

The purpose of this school is to teach home owners, electrical contractors, light companies, interior decorators and architects, the value of proper house wiring and home lighting.

On pages 12 and 13 we show a few reproductions of photographs made in Nela School, which will give you an idea of how proper lighting is demonstrated.

Most of the fixtures shown are interchangeable with others instantly, so good lighting can be compared with bad, and various forms of good lighting can be compared with each other.

Additional fixtures are hidden behind curtains and screens, in closets and between walls, in ingenious ways. These are lighted with a snap of a switch, and visitors can select any fixture and have it hung in the proper place to be studied for lighting efficiency and decorative effect.

The Nela School and model home is a laboratory of correct home lighting and some of the best home lighting in use today has come from this laboratory.

Cooke Training Priced at \$97.50

When you talk about Cooke Training to your friends, or meet a fellow who seems to be interested in it, I will be very grateful indeed if you will please be sure to remember that the price is \$97.50.

When you have an opportunity to enroll someone for the Course, please see that the enrollment blank you get signed has the \$97.50 price printed on it. I will be glad to send you a supply of these enrollment blanks if you will just ask me for them, the next time you write, or in a special letter if you want them right away. Thank you.

L. L. Cooke.

A Simple Way to Consider Transformer Connections

UNLESS some simple means is used to think of transformer connections they are apt to be perplexing. On the other hand if they are thought of in terms of some electrical equipment that is thoroughly understood, star and delta circuits and especially the current and voltage relations become manifest very quickly. The simplest electrical apparatus that we know of and which at the same time will suit our purposes in this comparison, is a set of dry cells serving as a supply and a pair of lamps acting as a load.

A transformer has two windings separate from each other electrically but coupled of course by means of a magnetic field. The transformer is after all an electric generator but we seldom think of it in that light because there are no moving parts. The primary receives energy from the line and the secondary because of electromagnetic induction is able to give energy to an entirely different circuit. Let us therefore compare the secondary windings with dry cells which are also generators by reason of chemical action.

A star transformer connection, (see Fig. 1) is a modified series connection because the output of one secondary must pass through the secondary of one of the other transformers before the circuit is complete. This is more understandable if one of the transformers omitted, that is, in thought. Actually it

must be there or we will not have a star connection. However, for the sake of instruction let's forget it is there. The transformer connection in Fig. 1 then resembles the battery connection in some respects.

The two dry cells are in series, consequently their voltages are added while the two lamps in series divide the voltage. We have the same state of affairs with the transformers but since the secondaries are not in phase they cannot be added by simple arithmetic. Instead of multiplying by two, the voltage of one transformer must be multiplied by 1.73. The primaries at the other end of the line divide the voltage similar to the two lamps in series but instead of dividing by 2, the voltage is divided by the factor 1.73. If the primaries of the receiving transformers at the other end of the line are connected in the same manner as the secondaries of the transformers supplying energy, the voltage drop across these windings must be the same, minus the voltage lost in the line due to current overcoming line resistance.

As to the current in star connected transformers, we find that it remains the same in the line as it does in the transformer windings. Here the star connection again acts like cells and lamps in a series connection the cur-

(Continued on page 16)

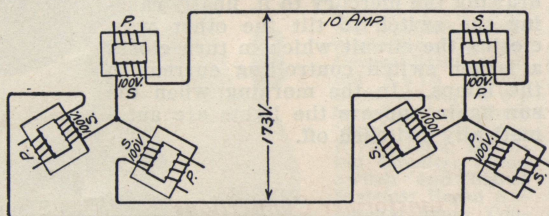
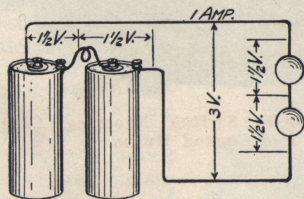


Fig. 1

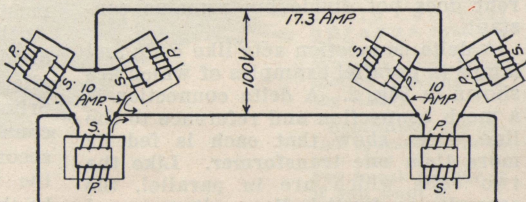
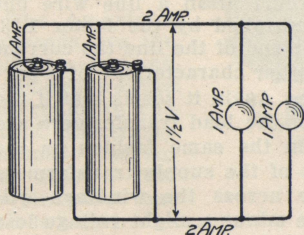


Fig. 2

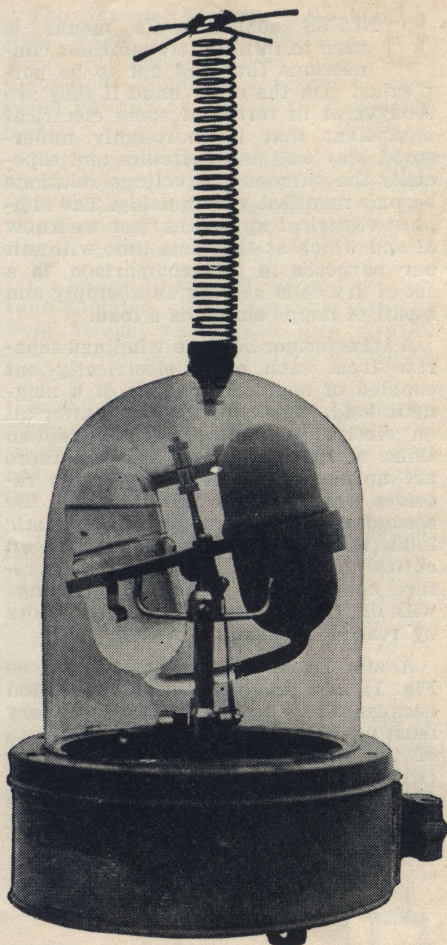
Automatic Switch Turns Lighthouse Lamps On and Off

THE switch shown in the accompanying photograph is designed for control of powerful lamps in lighthouses which may be either battery operated or supplied with electrical energy from some outside source. The purpose of the switch is to turn the lights on as soon as the light of day becomes so weak that mariners are no longer able to distinguish the coast or points of danger.

It will be noted that the switch consists of two glass bulbs with a glass tube running from one to the other. This tube contains mercury. One of the bulbs is of clear glass and the other has a heat absorbing coating. The difference in heat absorbing ability between the two bulbs is the secret of operation of the automatic switch.

The clear bulb allows sunlight to pass through unmolested, that is, it does not absorb any of the rays and consequently does not receive any heat. The other bulb absorbs all or most of the sun rays and is therefore warmer than its neighbor. As long as the sun is shining, the hot bulb forces the mercury into the cooler one. The bulbs are pivoted and free to tip in the direction of the heavier bulb, in other words, the bulb containing most mercury.

In bright daylight the heat absorbing bulb forces mercury into the opposite one keeping the switch in the position shown, but as soon as the sun's warming rays diminish, the hot bulb cools, drawing the mercury to it, finally causing the switch to tilt the other way, closing the circuit which in turn closes a larger switch controlling current to the lamps. In the morning when the sun again appears the lights are automatically switched off.



The Automatic Switch Showing Clear and Coated Bulbs

* * *

Transformer Connections

(Continued from page 15)

rent does not divide but remains constant.

A delta connection acts like cells and lamps in parallel examples of which are shown in Fig. 2. A delta connection is a mesh connection and reference to the line wires show that each is fed by more than one transformer. Like the two cells which are in parallel, the secondaries furnish line voltage equal to the voltage of the secondary windings.

Since the currents are out of phase, they cannot be multiplied by two to obtain the current in a line wire but must be multiplied by the factor 1.73. At the other end of the line the current divides, another characteristic of a parallel circuit. Again it seems that if the primaries of the load transformers are connected in the same fashion as the secondaries of the supply transformers the voltage across the windings will be the same minus a slight voltage loss due to line drop.

Now Ready for You—NEW COURSE IN **Railroad Signaling and Automatic Train Control**

*Ten New Special Work Sheets Now Ready for Distribution to
Students Interested in These Subjects*

WITH the co-operation of manufacturers of signal and train control equipment I have just finished a new ten lesson course on Railway Signaling and Automatic Train Control. The course is complete and covers installation, operation and maintenance of equipment.

Like all other Special Lessons which have been offered from time to time, these also, will be given to you free of any charge. If you want these lessons and will make use of them, all you have to do is drop me a line and ask me to send them to you.

I have been put to considerable expense in the preparation of these lessons, but as I have told you before, expense means nothing if I can be of service to "my boys." I want every student who can make use of the lessons to send for them. I urge you to do this now. On the other hand if you do not have need for this particular instruction, I would prefer to have you select some of my other Special Lessons instead—some lessons which would suit your own work better, and consequently, be of greater value to you.

The American railroads are the fastest, safest and most dependable railroads in the world. Electricity has made them so. Yet only a few people realize that this is a fact. Indeed very few

electrical men are familiar with the methods and electrical equipment in use on American railroads today, in spite of the fact that there is a steady, increasing demand for trained men with a knowledge of signal work and automatic train control equipment.

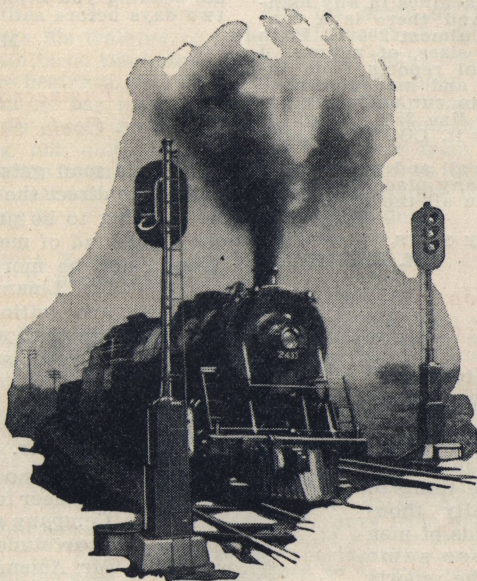
It was to meet this demand that I have prepared this Special Course which I know will be mighty helpful indeed to such of you fellows who might be interested in getting into this work.

Here is a partial list of what the new lessons cover:

Special Work Sheets 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Two and Three Position Semaphore Signals; Electro Pneumatic Signals; Signal Mechanisms; A. C. Floating Battery Systems; A. C. Primary Battery Systems; Induction Relays; Color Light and Position Light and Position Light Signals; Signal Maintenance; Testing and Adjusting; Mechanical Interlocking Machines; Non-automatic and Semi-Automatic Signal Control; Signal Control Circuits; Switch Control Circuits; Automatic Train Control Principles, receivers, translating equipment, etc.; Auto Manual Train Control Systems; Automatic Speed Control; General Railway Signal Auto Manual Equipment; Two Speed Control; Three Speed Control Amplifying and Decoding Circuits; Union Switch and Signal Systems; Regan Automatic Train Control System; Direct Contact Systems; Miller Automatic Train Control; Sprague System; Richards System; Wayside and Locomotive Circuits for the Above.

Remember, the entire course is free to you—but it's up to you to ask me for it if you want it.

L. L. C.



American Railroads Are the Fastest, Safest and Most Dependable Railroads in the World

The BEST TRAINING Brings the BEST JOBS

*Cooke Trained Men are
"Putting it Over" in Every
Branch of Electricity*

*—And the Same Train-
ing that Boosted Them
Will Boost You, Too*



Chief Engineer of Big Hotel Getting Results

Here's a fellow who takes pride, not only in his doubled earnings, but in the results he is getting for his employers as well. Does he give Cooke Training credit for his success? He certainly does.

1124 Curley Ave.,
Santa Barbara, California.

Dear Chief:

I sent in my finals, and I trust they meet with your approval. It has taken me some time to finish. But sometimes we have no control over certain conditions. One thing I do know is that the course has done wonders for me. I have increased my pay 50% and have the ability now to produce and not by hard, manual labor either. But because, I know; how and why; cause and effect. Results are what count and they show up on the Auditor's sheets.

I came here a year ago a stranger, but not any more, results have made me welcome to all. We have not had a hitch or a tie up of any machines in any manner, in this time. And there is a connected load here of almost 200 H. P. in different kinds and sizes, of motors. I have some wonderful reports from inspectors as to care and management.

I have been able to cut operating expenses in the power line 35%. Why? It is easy for me to say it. COOKE TRAINING.

It surely covers it all and you can use my name any time, any place, because I am a booster for you all the time.

Believe me to be

Sincerely yours,

WM. E. SMITH.

Gets Fine Position in South America

"It surely pays to study" says Mathew Stipee in his letter printed here. Your editor wishes he had kept count of the number of men who have said this same thing to Mr. Cooke. Actually thousands upon thousands of men have written those same words to him and the reports of their progress voluntarily sent to the Chief like this one from Stipee prove that they mean what they say.



Mathew Stipee

*C/o Compania Minera, Choco,
Pacifico, Andagoya, Via
Buenaventura, Rep. of
Columbia, South America.*

Dear Mr. Cooke:

Just a few lines to let you know that I accepted a position with the American Gold and Platinum Company in South America as an electrician. The pay is exceptionally good and I get all expenses and first class fare paid both ways. Well, Mr. Cooke, these are the happiest days of my life. I knew if it wasn't for your course that I wouldn't be able to get this position. Just think, little over 2 years ago I was working in the Butte mines at \$4.75 per day and now I will start at several times that amount and I don't have to even pay any board or anything else.

Well, Mr. Cooke, it sure pays to study! I always knew that my chance would come some day and with a little energy on my part by digging into your lessons I got ready for it. Thanks to you and your course. I am sailing December 3rd on Manchuria Panama Pacific Line and am sending you a photo of myself taken two days before sailing.

MATHEW STIPEC.

Head Engineer Employs Two Cooke Students

When a man gets up the ladder far enough to direct the work of other men, he is going to be pretty careful to get the right kind of men to work for him. What could be more natural than for Mr. Linam to pick men who are getting the same training that was responsible for his own success.

Wilcox, Arizona.

Dear Mr. Cooke:

I am now employed as head engineer for the Wilcox Power Company and we have two of your students in our employ. Mr. Amend Howes and Mr. D. T. Logan. They are both doing fine.

Sincerely yours,
WALTER LINAM.

Makes \$60 a Week Starting Salary

Just starting out in electrical work and earning \$10 a day for 7 hours work is a record for untrained men to try and equal. It simply can't be done. Malcolm knows what L. L. Cooke Training means and he will tell anyone if he gets half a chance.

Keystone, North Dakota.

Dear Chief:

Will write you a few lines this evening to let you know I am doing electrical work now. I am doing house wiring and contracting, also am doing electrical work for the Battle Creek Light and Power Company here. I will have to install several motors in a stamp mill here soon, as this is a mining town with two gold mines running now and two more to open soon.

Am making sixty dollars a week and only work about seven hours a day, and have all the work I can do.

You can bet that I am very glad I took your training and it shows what one can do with your training backing him. I will always boost for you and your school.

As ever your student,

C. L. MALCOLM.

**Wants to Finish Course Started
Nearly 10 Years Ago**

It's when a man puts his training to work and starts to cash in on the hours spent in study, that he begins to realize the real value of what he has learned. Dwight Morris has been pretty successful with his training not quite completed, but now he wants even greater success and rightfully realizes that further training will bring it.

Lyons, Kansas,
221 S. Grand Ave.,

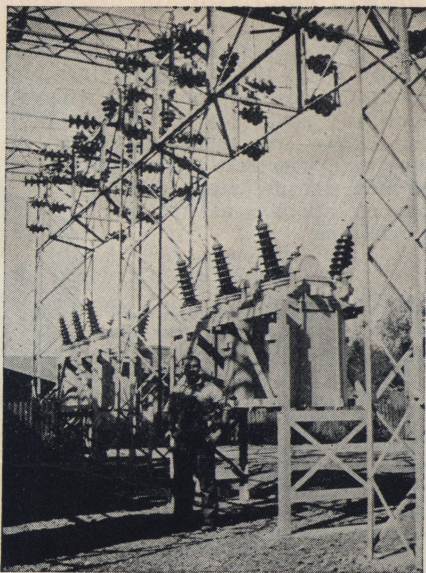
Dear Mr. Cooke:

No doubt you have forgotten me by this time, but I have not forgotten you and your wonderful School and what it has done for me. I am now Chief Electrician for the United Power and Light Corporation at Lyons, Kansas, and at present have working for me a young man who is one of your students. He has not got very far yet with his lessons, but he is a good workman and will make a good electrician.

Mr. Cooke, I am almost ashamed to ask you if I can take up my lessons and go on and finish my course from where I left off. I am in a position now to give it more time and would like very much to finish because I have learned the true value of your training.

Yours very truly,

DWIGHT T. MORRIS.



Dwight Morrow on the Job.

**With One Firm 5 Years—
Now Foreman**

Add the name of Clarence Smith to the rolls of Cooke Students who have gone up the ranks to the "bossing jobs." That's a habit Cooke Trained Electrical Men have. Their training fits them first to be good, dependable workmen, who know their jobs from A to Z, and then steps them up to direct the work of others. You simply can't keep a Cooke Trained Man down.

Holden, W. Va.,
Box 425.

Dear Mr. Cooke:

As I have not heard from you for some time I will attempt to show my appreciation for what you and the old school have meant to me, by writing you a few lines. I am O. K. and doing fine. Am making \$280 per month as foreman of the electric shop for the Island Creek Coal Company, one of the largest companies in the state. Have been with them for about five years. Mr. Cooke, would you please send me the remainder of the lessons on AUTOMOBILE IGNITION? I have from one to ten inclusive and would like to have the others, for I have considerable amount of this kind of work to do and have found your lessons on the subject very helpful as well as interesting. So thanking you for the lessons and for all you have done for me, I am

Your student and friend,

CLARENCE SMITH.

Laborer "Pinch Hits" in Emergency and Gets \$30 a Week Raise

One of the outstanding things in our memory of the life of Abraham Lincoln was his boyhood utterance—"I will get ready and some day my chance will come." How true this is in the life of every man who does "get ready." And the men who are ready somehow or another always get the chances.

55 Avenue B,
New York, N. Y.

Dear Mr. Cooke:

I am going to tell you how much your lessons did for me, and I always did say that the Cooke School is the only school where you can learn Electricity. I make \$55 and I only work 44 hours a week, and before I started studying I was a laborer with the same company only getting \$25 a week. I got my new position because one time the whole shop stopped altogether, that means we had no power. My boss tried to obtain an Electrician, but New York is a busy city, and it is not so easy to get a mechanic in a minute so I told him I was taking a course in Electricity with you and opened my Job Ticket Handbook and I showed him the page on repairing motors. He told me to go to work—I soon found the trouble, repaired it and the shop started again. On Saturday the boss called me to his office and told me that from then on my salary would be \$55 a week and that I would have steady work. Your Job Ticket Handbook is responsible.

When anyone asks me I tell them that your school has done me a lot of good.

Yours truly,

MICHAEL NIEWIESCIUK.

Training Brings Friedmann Four Times Former Salary

When a fellow earns only \$57.50 a month and then his salary jumps to that much each week, it's pretty certain he knows what caused the jump. And you'll notice he doesn't hesitate to give Cooke Training full credit for his success.

Box 609—25 South St.,
New York, New York.

Dear Mr. Cooke:

When I started your course the only thing I knew about Electricity was to start and stop a dynamo, education none, that is, one year grammar school. Before I took your course my salary was \$57.50 a month. At present it is \$205 a month, room and board included. At present I am employed by the U. S. Shipping Board on Ships owned by them as 1st Asst Engineer. I have to thank you for the upward climb; without your Course I would still be earning \$57.50 a month.

You may use this letter as you see fit.
Sincerely yours,

LOUIS FRIEDMANN.



Michael
Niewiesciuk

Now Chief Engineer with Salary Doubled

When the "Big Boss" hands out the Chief Engineer and Chief Electrician Jobs you can bet he is pretty certain that the fellows who get them know their stuff. Fred Wilson's new job as "Chief" proves that his employers certainly did take advantage of his training.

St. Paul, Minn.
379 Walnut St.,

Dear Mr. Cooke:

I take this opportunity to express my gratitude for the benefits that I have derived from your electrical course. Along with the study, I have enjoyed your personal help and encouragement.

All that I know about electricity, I have learned from you and today, I have a good knowledge of it and I am climbing up the ladder of success, thanks to the excellent training that I received from you.

When I enrolled for your course I was working as a Steam Engineer at a salary of \$145 a month. I have now worked myself up to Chief Engineer and Chief Electrician, and at present I am so employed with a salary of \$250 per month with free house, heat and light.

I also passed the State Examination for Electrician's License, which in this state is considered hard to pass, but thanks to your training I came thru with a high standing.

In concluding, I again want to tell you how proud it makes me feel to have my Diploma hanging in my office, and I am right there to let other fellows know about your wonderful course.

I am, and will always remain a booster for your Course.

Very truly yours,

FRED WILSON.

Service Manager for Big Radio Distributors

Radio, the youngest but one of the more important branches of electricity offers some wonderful opportunities to Cooke Trained Men. Note the report from Earl Gordon who is making good in a big way.

618 E. 6th St.,
Oklahoma City, Okla.

Dear Mr. Cooke:

You may be interested to know that I am now Radio Service Manager for H. N. Night Supply Company, distributors of Fada Radio in the states of Oklahoma and Texas. With an increase in salary of 33-1/3% since I enrolled with your school.

Thanking you for the interest you have shown me, and for your wonderful course in electricity, I am

Yours truly,

EARL P. GORDON.

Boss Says "Cooke Course Is Best"

That's why hundreds of employers have already, and are constantly recommending to their employees that they enroll for Cooke Training. It's just as important to the boss that he gets the right kind of men as it is to the men



Gordon Simmons

that they get the right kind of jobs. But the boss has even more at stake. Think of entrusting the \$38,000.00 job which Gordon Simmons tells about to incompetent, untrained men. Wise business men simply won't do it. They've got to pick their men, and when men are picked training counts most.

1313 Mable Ave.,
Flint, Michigan.

Dear Mr. Cooke:

I take great pleasure in telling you about my rapid advance. When I enrolled I repaired radios and received about thirty dollars per week. I later took a position as a second-class wire man. After finishing lesson forty I was going up in High. Now I am Chief Job Manager for one of the largest electrical Construction Contractors in the State. Our jobs run from fifteen to eighteen thousand dollars each. We just landed another good job at thirty-eight thousand dollars. The job is to wire three large schools and install fixtures, automatic phones, signals, electric clocks, All work to be in conduit.

My Superintendent told some facts about your Course. He told my helpers that they would never amount to much, if they did not study and work for the interest of their employer. He said that your Course is the best obtainable.

I have just completed the large Beurstons job. The building is so large that it takes in more than one ordinary city block. They had to close one street to obtain room for the building.

I have only a seventh grade education but I found your lessons easy to master. I finished the hardest one in one hour. My salary has gone up about sixty-five dollars per week and I have the promise of another raise.

I will send some pictures of my work after they are finished.

Your student,
GORDON SIMMONS.

\$50 to \$75 a Week and a Big Future

Graduate Student Onovi has the right idea for success. While reveling in the grand and glorious feeling of making three dollars where he made one before, he doesn't lose sight of the wonderful future before him with opportunities for even bigger money making.

116 Highland,
Newark, N. J.

Dear Chief:—

When I began studying with you, I knew nothing whatsoever about Electricity. I didn't even know how to connect up a door bell. Before I started to take your Course I was only making \$20.00 a week working as a laborer. But now I make \$50.00 to \$75.00 a week. I'm doing my own contracting on housewiring. Thanks to your splendid Course I have a great future before me.

SALLEE ONOVI.

Lee Says—"Service Certainly Is Your Motto"

"Satisfied Students," says L. L. Cooke to his staff, "are the only kind of students that will satisfy me. In your contact with my students see that every last one of them is satisfied." That's the way the Chief works always. It's that wonderful help of his—that wonderful understanding of the needs of his students that brings such enthusiastic letters as this one from Allan Lee.

Box 324,
Portage La Prairie,
Manatoba, Canada.

Dear Mr. Cooke:—

I have just completed my last lesson of the regular course and I just want to express my appreciation of the consideration and service that you and your staff have given to me in the course of my studies. Whenever I seemed to slack off and give up, your letters of cheerful encouragement boosted me up, and I went at them again with a will. Any problem I didn't understand I asked your information bureau for help and my difficulty was promptly ironed out for me.

"Service" is certainly your **Motto**, Mr. Cooke, and one that you live up to in the highest respect, and I hope that you will have good health and prosperity for many years to come and that the service you are giving to us young fellows who are not blessed with a fortune and education will grow larger and better until L. L. Cooke and his staff are known the world wide over.

You can certainly count on me for a booster of L. L. Cooke Training. The fellows around town are beginning to sit up and take notice, especially those who laughed when I enrolled. For in one year, I rose from a farm hand to a first



Allan L. Lee

class projectionist and electrician and now it's "take it to young Lee, he can fix it." What is it that is responsible? I can sum it up in two words. "Cooke Training," back of which is the brains and understanding of L. L. Cooke and his staff of electrical engineers.

Well, I must be away now, and get to work.

I remain
Yours sincerely,
ALLAN L. LEE.

The QUESTION BOX

Question

We have connected on our board, a three phase power factor meter that refuses to give reliable indications. Without our condenser, the P.F. meter reads 50% lag and as the condenser is started, the meter runs up past unity power factor and finally comes to rest at 50% lead. We have reversed the connections on the current and have changed the potential leads but without results.

Either the indicator comes to rest at 50% lag or 50% lead. What is the trouble?

Answer

It appears that the trouble in this case is due to wrong phase sequence at the potential connections. The terminals are numbered 1-2-3. Phases A-B-C must be connected to these terminals in the order named, that is, A-B-C, B-C-A, or C-A-B but not C-B-A or in that order.

Make a sequence test as outlined in your Job Ticket 60A and connect the potential leads accordingly. If all other connections are properly made and the sequence is correct, your power factor meter should give a correct indication of the power factor.

Question

I have a large motor under my care which has about 750 commutator bars. About every week every fourth bar becomes black making it necessary to polish the commutator. The motor seems to run all right in every respect. What is the cause of blackening?

Answer

Apparently you have a wave wound machine having a quadruplex winding. One of these windings is open or at best has a loose connection which will be



found, most likely at one of the commutator connections.

Even though the machine may operate without any apparent harm, the fault should be corrected before too much copper is polished from the commutator.

Question

Will you tell me the most practical method of telling the difference between an accumulative compound motor and a differential compound motor without testing the polarity of the field coils?

Answer

The simplest method of determining whether a motor is compound or differentially connected is by connecting a jumper across the series field, then noting the changes in speed. If the motor speeds up, this signifies that it is compound for shunting the series field weakens the total field strength, and a weaker field causes increase in speed.

If the speed of the motor decreases when the series field is shorted, it signifies that the motor is differentially connected for a stronger field decreases the speed. The speed changes are of course due to decrease or increase in counter-electromotive force.

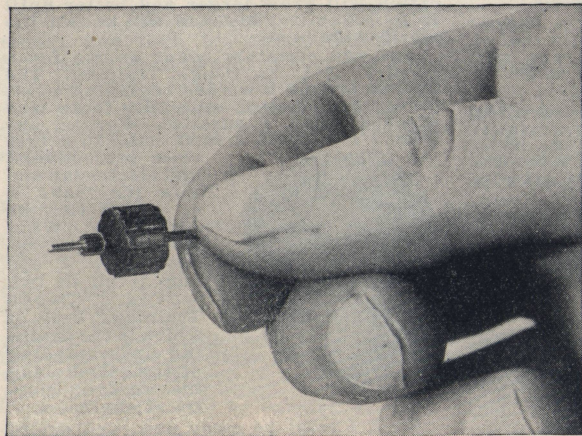
Question

A group of two or more polphase motors is operating on a common line and one of the conductors of the line becomes broken, leaving the motors operating single phase. Could one of the motors in the group, after being stopped, be started again?

Answer

Yes, provided it is not so large as to excessively overload the other motors in operation. The motors in service act as phase changers to convert the single-phase power into polyphase for starting the motor.

Motor Smaller Than Postage Stamp



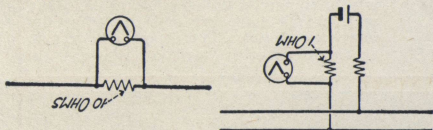
Fly weight motor held between the fingers of a man—showing minute construction.

A motor so small its rotor could be wrapped in a postage stamp is used by the Westinghouse Electric and Manufacturing Company, for timing the OB watt-hour meter demand register. It is the smallest synchronous motor ever manufactured for practical use. Four million of these complete motors, together with their reduction gears, would be required to balance a large 8,000 hp. motor recently built in the Westinghouse shops. The diameters of their shafts are in the ratio of 512 to 1. The rotors are still smaller in proportion as 37 million are required to equal the weight of the large one.

Practical "Kinks" and Interesting Facts About **ELECTRICITY**

Using a Voltmeter As An Ammeter

WHERE it is desired to make current readings with the use of a voltmeter, all that is necessary in addition to the voltmeter is a known resistance of some value that the readings can be made direct or can be had by multiplying the meter reading by a simple constant.



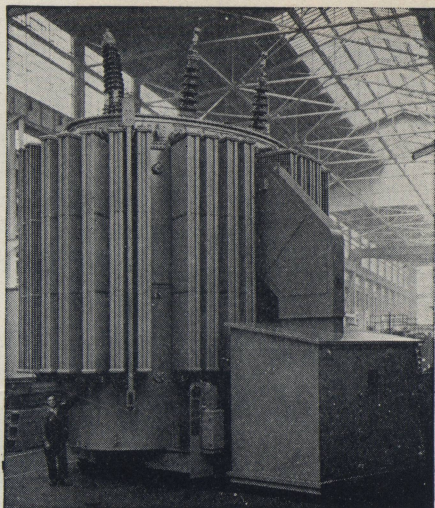
The resistance must be connected in series with the load and the meter in shunt with the resistance as shown in the accompanying diagram. If a 1 ohm resistor is used, every ampere of current will cause a drop of one volt. Thus, 2 amperes flowing through a one ohm resistance will cause a drop of two volts. Inversely, if the meter shows a drop of 2 volts, we know at once that the current in the line is two amperes.

If a ten ohm resistor is used, the drop will be 10 times as much and it follows that the voltage reading must be divided by 10 in order to get the actual current in the circuit. A ten ohm resistor would be suitable where the voltmeter has a high voltage scale reading but suitable where a 10 ohm resistance would lower the current to such an extent that the circuit does not carry approximately normal current.

If a milli-voltmeter is obtainable, a very slight resistance can be connected in the circuit but with high resistance the characteristic of the circuit is changed somewhat and the chance for error is greater. Taking these things into consideration, this kind is still worth while knowing.

Safety In Burning Battery Connections

After a battery has been charged, it is usually full of gases, hydrogen and oxygen which are in the right quantities to be dangerously explosive. To safely burn connections on a battery that has just been taken off the line, lay a wet folded cloth over the vents or openings and you are assured of perfect safety.



Westinghouse Photo

Largest Transformer in the World

Capable of furnishing sufficient electrical power to light, heat, and transport, a city of half a million people, seven transformers, the largest in the world, have just been completed at the Sharon Works of the Westinghouse Electric and Manufacturing Company. The gigantic electrical mastodons are for use near Philadelphia in connection with the new Conowingo Dam project of the Philadelphia Electric Company.

The transformers are gigantic in size and appearance. Each stands over 31 feet in height, weighs over 200 tons and has a voltage of 220,000 volts which is the highest in actual use in electric power transmission. Each year \$12,000,000 worth of electricity will pass through the seven transformers.

Several cars will be required to ship each transformer. To carry the heaviest part, railroad officials found it necessary to build a special flat car, having twelve wheels and a carrying capacity of 220,000 pounds.

The seven transformers require 20 car loads of oil for cooling and insulation.

WHAT'S NEW IN ELECTRICITY

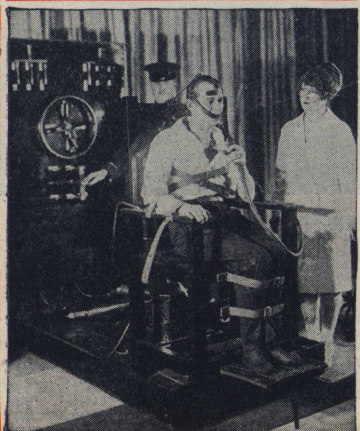


Radio Television Places World Before Eyes

Dr. E. F. W. Alexanderson, the inventor and D. MacFarlane Moore of General Electric Company watching demonstration of the radio television device.



Dr. E. F. W. Alexanderson, the inventor at his radio television device which transmits images by radio. One section is a radio set and the other the television device. The image one sees is accompanied with words or music.



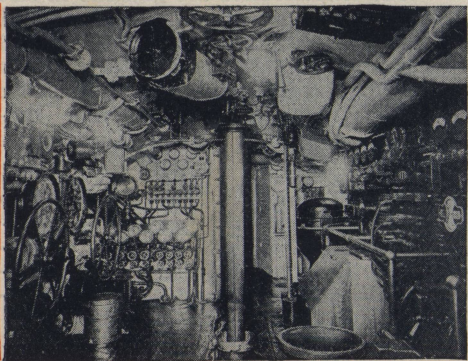
DEFIES ELECTRICITY TO KILL HIM

Bermays Johnson allows himself to be electrocuted in a regular electric chair on the stage of the Hippodrome Theatre, letting 2500 volts at 350 amperage go through his body.



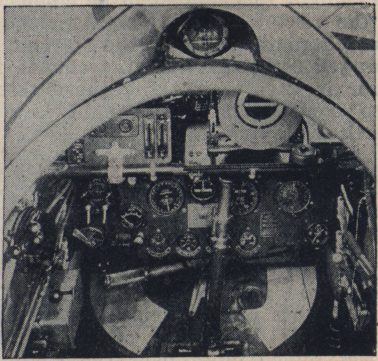
MANICURING BY ELECTRICITY

And now they are doing manicuring by electricity. This is Gertrude Messenger of the "Sunny" Company using La Freylac an electric manicuring machine which does the job just three times as fast as the old fashioned manual method.



CONTROL ROOM OF SUBMARINE S-4

An official Navy photograph showing a view from the aft end of control room of the S-4.



"BLIND" FLYING NOW SAFE

Complicated instrument board of the plane used by Capt. Ocker, and Dr. Myers, for their system of "blind flying."